REPUBLIC OF TURKEY
MINISTRY OF ENERGY AND NATURAL RESOURCES
GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS

YUSUFELI DAM AND HEPP PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

DRAFT FINAL (Rev F)

ENVIRONMENTAL CONSULTANCY CO.

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EXECUTIVE SUMMARY

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I. PROJECT BACKGROUND

Yusufeli Dam and Hydroelectric Power Plant Project is located on Coruh River, about 40 km southwest of Artvin City center and about 10 km downstream of Yusufeli Town. (Figure 1) Coruh River which is one of the significant surface water resources of Turkey rises at the North of the Erzurum Plateau, and flows through East Anatolia and the East Black Sea Regions of Turkey to finally after 410 km reaches the Black Sea near Batumi in Georgia. On the way it flows about 390 km on the Turkish territory and about 20 km through Georgia. The Yusufeli Dam Axis is located 800 m downstream of the confluence of Oltu and Coruh River.

Yusufeli Project is to be built as a part of the Development Plan of Coruh River, which was developed on a Master Plan level in 1982. The hydropower projects on Coruh River are planned in three groups as; lower Coruh (Muratli, Borcka and Deriner), of which Muratli is in operation and Borcka and Deriner are under construction, middle Coruh (Yusufeli and Artvin) and upper Coruh (Laleli, Ispir, Gullubag, Aksu and Arkun) projects. The feasibility studies and the final design for the project were completed in 1986 by JICA and 1990 by EPDC lead engineering consortium, respectively. In accordance with the Coruh River Development Plan, Artvin, Deriner, Borcka and Muratli hydropower projects are located in the downstream and Arkun, Aksu, Gullubag, Ispir and Laleli projects in the upstream of Yusufeli Project.

Yusufeli Project was put into the 1997 Investment Program by the Turkish Government. Ministry of Energy and Natural Resources, General Directorate of State Hydraulic Works (DSI) is the owner of the project and the Consortium[1] is the contractor of DSI for building the project. Funding for the project investment will be obtained from international and national finance sources. The Turkish Electricity Production Authority (EUAS) is the responsible agency for the operation of hydroelectric power plants in Turkey. After construction of the Project, DSI will transfer the Hydroelectric Power Plant to EUAS for operation.

Yusufeli Dam and Hydroelectric Power Plant Project will be constructed according to the design as set out in 1990, consisting of a rock fill dam (with a height of 223 m from the riverbed), a 540 MW underground type powerhouse, and the associated switchyard site. Also, two relocation roads (55 km relocation section of Artvin-Bayburt and 31 km relocation section of Artvin-Erzurum highway) will be built to in the scope of the project to replace the roads that will be inundated by the reservoir.

Environmental studies regarding the Yusufeli Project were first conducted in 1998, and additional work was carried out in 2000 and 2002. In spring 2004, work was continued with detailed baseline studies for the preparation of this EIA report, which include the vegetation – land use – habitat mapping studies to identify actual status in the project impact area using state of the art techniques. For the Resettlement Action Plan (ENCON, 2006) socio-economic surveys and other related studies were carried out in spring 2005.

[1] The members of the Consortium are DOGUS Insaat ve Ticaret A.S. (Turkey), ALSTOM (Switzerland, France and Brasil), COYNE & BELLIER (France) and DOLSAR Muhendislik (Turkey) with DOGUS as the leader.

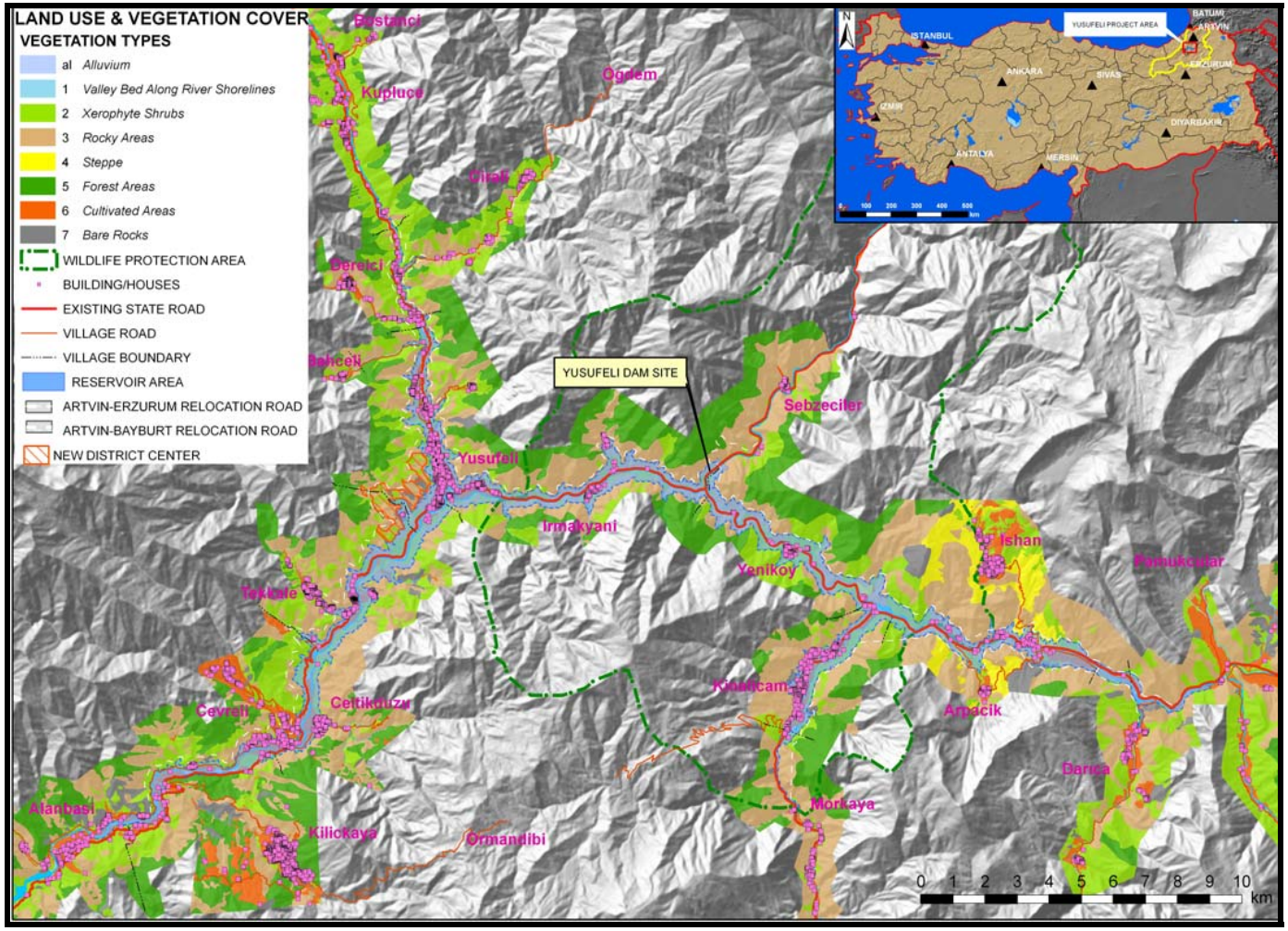

Figure 1. Map showing Project Location in Turkey and Land Use – Vegetation Cover Properties in Project Area

The preparation of an Environmental Impact Assessment Report (Environmental Impact Statement) for Yusufeli Project is not required under the Turkish Environmental Impact Assessment Regulation because it was exempt from EIA by the Ministry of Environment and Forestry due to the fact that the final design of the project had been approved by relevant authorities prior to the promulgation of this Regulation in February 1993. However, all project activities will need to comply with the requirements of all other environment related Turkish laws and regulations in force.

This Environmental Impact Assessment Report (EIA) was prepared to fulfill the requirements of international lending organizations involved in financing of the project investment. The preparation of the EIA Study was guided by the relevant World Bank environmental safeguard policies for dam projects. Thus, this environmental impact assessment study was prepared along the requirements of World Bank Operational Policy (OP) 4.01 Annex A (Environmental Assessment) and Annex B (Environmental Policy for Dam and Reservoir Projects), and OP 4.04 (Natural Habitats), where OP 4.12 (Involuntary Resettlement) was also considered with regard to the impacts on socio-economic environment. The latter impacts and the respective mitigation measures are described in detail in the Resettlement Action Plan for Yusufeli Project (ENCON, 2006).

II. PROJECT DESCRIPTION

Role of Yusufeli Project within the Coruh River Development Plan

In the Coruh River Development Plan 10 hydro projects in series along the main river in a cascade style are planned on the main course of Coruh River. Together they will have an installed capacity of 2,536 MW and will be utilized for energy generation of 8,320 GWh/year, when all the proposed projects (10 projects) have been taken into operation. In this development plan, three large reservoirs are to be constructed at Laleli, Yusufeli and Deriner sites, located at the uppermost, middle and lower parts of the Coruh, respectively, to regulate the Coruh River flow. By its high regulating capacity, Yusufeli Project is a key project which will increase the firm energy of the Lower Coruh dams, i.e. Deriner (under construction), Borcka (under construction) and Muratli projects (under operation), by 467 GWh/year and an increase of 160 MW in dependable power of these plants will be realized.

The Lower Coruh projects are either in operation or under construction, which were all undertaken on a full-financing basis (national and international finance). Among these Muratli Project has been taken into operation in June 2005 and construction is more than 90% complete for the Borcka Project. Also, more than 70% of the construction of Deriner Project has been completed. The final designs for middle Coruh Projects (Yusufeli and Artvin) are completed, and these projects will be constructed by the Consortium with full financing. The feasibility reports for all upper Coruh Projects were prepared in 1989. Among these, Laleli Project will be constructed by a protocol signed between Turkish and Canadian Governments. The other four projects Ispir, Gullubag, Aksu and Arkun will be developed by private Independent Power Producers (IPP), under Turkish Electricity Market Licensing Regulation after Water Usage Right Agreements will be signed with DSI. Tendering is presently underway.

Consultation between Turkey and Georgia regarding the hydropower development on Coruh River were started in 1996 with construction preparations for Deriner dam. Since then Turkish and Georgian experts have been conducting joint studies that will serve to identify, monitor and evaluate changes, which may occur over time in the downstream of the Coruh projects on the Georgian section of the river, including the river mouth and the Black Sea coastline.

Yusufeli Project Salient Features

The Yusufeli Project comprises of the following main features:

- A **rockfill dam** (with a height of 270 m from the foundation) having a slightly inclined impervious core).
- A **reservoir** of 33 km^2 surface area at high water level (at 710 m). Total storage volume is 2,130 million m^3, active storage is 1,080 million m^3. The reservoir is long and narrow shaped (total length of approx. 60 km, average 550 m width) and is including reaches of the tributaries Barhal, Oltu and Tortum rivers). The maximum water depth will be about 215 m. The retention time of the water will be approximately 195 days.
- A 63 m wide **spillway** and two **diversion tunnels** in the right abutment (Tunnel-1 and Tunnel 2), of which Tunnel-2 will be converted into the dam bottom outlet.
- A 540 MW underground type **powerhouse** (3 units with Francis type turbines), a cable-head yard and a conventional type switchyard located approximately 8 km upstream of the dam site.
- **Quarries and borrow areas** upstream of the dam site. The total volume of the dam is in the order of 20 million m^3. The rock materials will also come from the excavations for the permanent works and the excess material will be stored in the **disposal sites**.

- The **permanent service roads** from main access roads to the project facilities, the **right and left by-pass roads** and associated bridges, which allow maintaining the external highway traffic during the construction of the works (set at an elevation above 530 m), the **temporary main service roads** that provide access to various main units of the project from the main service roads, by-pass roads, borrow areas and quarries, and the **secondary service roads** that provide access to the various work sites and connect the site to the top level of the quarry from the main service roads.
- The **camp facilities (permanent and temporary)** to meet the housing and social needs of about 1,800 workers in the peak periods during construction and approximately 100 people during operation.
- Two **relocation roads** (Artvin-Bayburt Road – 55 km of relocation section; Artvin-Erzurum Road 31 km of relocation section) to replace the main road network to be inundated by the Yusufeli Reservoir.

A number of new 380 kV and 154 kV lines power are built by Turkish Electricity Distribution Corporation (TEIAS) in the context of the development of the lower and middle Coruh projects. Yusufeli HEPP will be linked into a new 380 kV transmission line connection from the Black Sea coast to Erzurum. The constructions of the 380 kV line sections, which are funded by the World Bank, are more than 90% complete. Provisions are made at Yusufeli Switchyard that Yusufeli HEPP at a later stage can also be connected to regional 154 kV lines (Borcka HEPP-Artvin HEPP-Yusufeli HEPP (80 km), and Yusufeli HEPP-Tortum-Oltu (55 km)) for which planning is completed. EIA Reports for all 380 kV and 154 kV projects in the context of the lower and middle Coruh are available from TEIAS. The 380 kV lines are World Bank funded and EIA reports were approved. All EIA Reports were approved by the Ministry of Environment and Forestry in 2003.

Operation Mode: Yusufeli HEPP will be operated by Turkish Electricity Production Authority (EUAS). It is planned that Yusufeli will operate as a peaking power plant. In peak mode operation three turbines would be operated for the daily peaking (8-hours/day), providing an output of 315-540 MW, depending on the available head, to the national electricity transmission grid system. During this reservoir operation the maximum discharge from the three units would be 321 m^3/sec at the reservoir high water level of 710 m ASL.

Implementation Schedule: According to the proposed schedule, construction of the project will take approximately seven and half years (88 months). Water impoundment is planned to start on month 76 of construction. The construction of both of the relocation roads will be completed before impounding by month 75.5 of the construction activities. Relocation of Yusufeli Town and Resettlement will be completed before impoundment.

Project Cost: The total funding requirement of the Project up to commissioning is estimated to be 855 million US$.

III. ENVIRONMENTAL BASELINE CONDITIONS

III.1. Physical Environment

Geology: Sedimentary and volcanic rocks ranging from Jurassic to Tertiary age and regional metamorphic rocks ranging in age from Pre-Permian to Permo-Carboniferous are distributed in the Coruh River basin. Basement rocks of the Yusufeli Dam Site are Ikizdere granitic rocks, which are widely exposed on both banks. Alluvium is found along the riverbed, at the dam site this is about 50 m in thickness. Based on the lithological characteristics of the area the Yusufeli Reservoir is considered to be sufficiently watertight. The project area is located approximately 150 km north of the active fault groups in eastern Anatolia in a 3rd Degree earthquake risk zone (ground acceleration 0.2 g – 0.3 g) according to the Turkish Earthquake classification. No mineral, or thermal or geothermal resources are located in the Project area.

Slope Stability: In the area of the future reservoir and the borrow sites two relatively large-scale landslides are located. Vecanket landslide (approx. 1km², 49 million m³) is on the left bank of the Barhal River approximately two kilometers upstream from the confluence of the Coruh River and Barhal River. Gorgulu landslide (approx. 1km², 55 million m³) is on the left bank of the Tortum River about four kilometers upstream from the confluence of the Oltu River and Tortum River. Downstream of the Yusufeli Dam, Havuzlu and Demirkent landslides are located within the area of the future Artvin reservoir.

Erosion: In Yusufeli catchment area, especially rangelands and barren lands, generally found on steep slopes and hilly and mountainous areas have high erosion risks. About half of the catchment area has a relative medium to high erosion risk. The areas with rather high risk are mostly located in the southeast, southwest and north parts of the Yusufeli Project catchment area. In particular the area through which Oltu river runs has high erosion risk due to the fact that there are considerable slopes and rather soft soils that are non-resistant to erosion.

Soils: Due to the steep topography of the region, bare rocks and rubbles cover about one third of the future reservoir area. Brown forest soils comprise about one half of the area, and alluvium is present along the riverbed in about one-third of the future reservoir area. In general, slopes are steeper than 30% in the study area and the depth of soil on slopes varies between 0 to 20 cm. Agricultural used soils are found in the valley bottom or on terraces where meliorated soils have been accumulated by long time agricultural activities of the villagers. The depth of the soils in these relatively flat areas reach 50 to 90 cm. The majority of the alluvium is medium-grained and groundwater table is high due to poor drainage.

Land Use: The steep topography in the project area is the principal factor determining land use. The project area is steep and rocky for the most part. Cultivated areas, mostly irrigated fields, are therefore generally located near the river. On the lower valley slopes, man made terraces are found and also in smaller plots of terraces on the valley bottom, fields for growing rice, corn, and wheat and orchards are found, occasionally greenhouses are established. Orchards are located usually on the terraces on the slopes. Forests are found above 700 m ASL elevation. About one-third of the reservoir area is rocky area and about one-fourth is covered with shrubs. Cultivated areas cover about one-fifth of the reservoir area, mostly irrigated fields. Orchards comprise about one half of the irrigated areas and vegetable, maize and rice fields comprise the other half. Rain-fed fields cover about only 2% of the reservoir area and forest comprise less than one percent.

Climate and Air Quality: The Yusufeli Project area is located in the inland part of the East Black Sea Region. The seasonal distribution of precipitation is fairly even in the region, typical of Black Sea climatic conditions. In the catchment basin of the Yusufeli Dam Site continental climate is predominant, with mean annual rainfall of 440 mm and the number of

days of precipitation is about 65, annually. In the Yusufeli catchment area, the rainy season extends from March to June. Yusufeli Town is situated in a location protected with respect to climate in the valley bottom on Coruh River and Barhal River confluence and experiences overall mild climatic conditions. About half of the annual precipitation occurs during this period. May and June have the most precipitation with about 43 mm, while August has the least precipitation with 15 mm. The mean annual rainfall is about 310 mm at Yusufeli Station. The annual mean temperature at Yusufeli is about 14°C; July to August being hottest, with a mean maximum temperature of 32°C, and January being coldest, with a mean minimum temperature of -2.5°C. The prevailing wind direction for Yusufeli Town is southeast and wind speeds are rather low (averages up to 2 Beaufort).

Hydrology: The catchment area of Coruh at the Yusufeli dam site is about 15,250 km^2. The drainage area of the Coruh abruptly increases by 1.9 times after the Oltu River joins the main stream 800 m upstream from the dam site. The average flow at the dam site was calculated as 126.7 m^3/sec (or 3,995 million m^3/year) based on hydraulic data for 1942-2003 period. About half of the annual flow of the Coruh at concentrated in four months from March to June with an average peak of about 395 m^3/sec in May. Snowmelt starts in March and extends to May, and it is followed by the wet season lasting from April to June. The 50-year return period flood flow was calculated to be about 1,500 m^3/sec. Lowest flows usually occur in January with a long term average minimum flow of 45 m^3/sec.

The gradient of the Coruh River in the reservoir reach and downstream of Yusufeli Dam to Artvin Dam site is approximately 0.6%.

Sediment Transport: About 83 % of the suspended sediment load (6.2 million tons/year) of the Coruh, which reaches the river mouth at the Black Sea on the Georgian Coast, originates from Turkish territory. The remainder of the sediment amount (17% or 1.27 million tons/year) being transported by the Coruh River to the delta originates from the area downstream of the Muratli Dam, and from the two tributaries of the Coruh on Georgian territory (Acara and Macahela). The sediment amount estimated for Yusufeli Dam axis is 4.13 million tons/year. The suspended sediment of Coruh River is composed of 33% sand, 37% silt and 30% clay.

Water Quality: The water quality measurements on Coruh, Oltu, and Barhal Rivers indicate that the water quality is highest in Barhal River (Class I), and lowest in Oltu and Tortum Rivers (Class III). The relatively low water quality results from natural siltation rather than organic pollution sources. Additionally, the upstream section of Coruh River has higher water quality than the lower section of the river.

Groundwater: Groundwater quality in the project area is influenced by the geological background, no significant sources of pollution are known. Groundwater use is basically non-commercial for domestic purposes (public water supply network in Yusufeli town and individual wells in villages). There are also some small springs in the area, but they do not provide sufficient quantities of water to meet the domestic water requirements.

Surface Water Use: In the Project area, water from Coruh River and tributaries is mainly used for irrigation. Fruits, vegetables, and rice are the main crops depending on the river water. In the area to be inundated 60 % of the households directly or indirectly (via pipes) use river water to irrigate their agricultural plots. The annual amount of river water used for irrigation is estimated to be some 13 million m^3 (0.42 m^3/sec). Other than for irrigation, there is no significant domestic or industrial use.

Sewage produced at Yusufeli Town is collected via a sewer system and directed to Coruh River without treatment. Wastewater from the villages is generally disposed via seepage pits.

III.2. Ecological Resources

Flora and Vegetation Communities

Due to the steep topography of the region, bare rocks and rocky areas cover about one half of the project area. The steep slopes in the project area are covered with little vegetation. Scattered trees exist generally at small villages along streams, and there are occasional short trees on mountainsides. At the dam site, sheer cliffs rise at both banks with bare rock exposed. There is also little natural vegetation in the area to be flooded by the Yusufeli Reservoir that mainly includes scattered trees, shrubs and meadows. Five main vegetation cover types were identified in the study area (reservoir and vicinity < 1,000 m ASL). These comprise (i) valley-bed and river shorelines (1%), (ii) xerophyte shrubs (30%) where Christ's thorn-maple-cade communities dominate, (iii) rocky areas (40%) with *Topukcayi*-woundwort and Corn flower - *Topukcayi* communities, (iv) steppe (2%) composed of Vetch-centaurea communities, and (v) forest areas (9%) mainly Greek juniper-cade-hop hornbeam communities. In addition, there are cultivated areas (11%) with mainly irrigated fields and orchards, and bare rocks (3%) and other surface cover (4%).

The project area is located within in the European-Siberian floristic region. However, due to the mild microclimatic conditions in the Coruh Basin, elements of the Iranian-Turanian dominate, and Euxin and Mediterranean floristic regions are also seen in the region. In the field studies 509 plant species from 88 families were identified. The endemism ratio in the study area is around 10%, which is lower compared to overall Turkey (30%). Most of the endemics identified in the study area are widespread either in Turkey or in East Anatolia, however, some are regional endemics that are endemic to the study area and its wider vicinity (Yusufeli and its vicinity, Coruh River Valley, Artvin Province, and neighboring Erzurum Province) and have limited distribution. Among the 56 endemic plants 20 species identified in the area are assigned to one of the three threat categories in the Red Data Book of Turkish Plants, among those six classified as 'critically endangered' (*Centaurea straminicephala, Centaurea leptophylla, Lathyrus woronowii, Ferula mervinii (nom.nud.), Anthemis calcarea var. calcarea, Anthemis calcarea var. discoidea*) and five 'endangered' (*Clypeola raddeana, Morina persica var. decussatifolia, Campanula troegerae, Verbascum gracilescens, Asperula virgata*). In addition to these, the non-endemic but narrowly distributed species *Reseda globosa* is classified as critically endangered. None of the flora species identified in the study area, endemic or non-endemic, is on the IUCN Red List. One non-endemic species (*Orchis punctulata*) is listed in Annex 1 of the Bern Convention. This species is also on Appendix 2 of CITES, together with the non-endemic *Anacamptis pyramidalis*. Both species are widely distributed in Turkey.

Fauna and Habitats

In the field studies, a total of 24 mammal, 79 bird, 8 reptile, 2 amphibian, and 12 fish species, and in addition to the 161 invertebrate species, were identified in the study area.

<u>*Mammals:*</u> Wild goat (*Capra aegagrus*), Lesser horseshoe bat (*Rhinolopus rhipposideros*), Mediterranean horseshoe bat (*Rhinolopus euryale*) are the three mammal species of highest concern status regarding both national and international criteria (Annex 2 of the Bern Convention, and classified as vulnerable (VU) in IUCN Red List). The species are protected under Appx.1 (i.e. hunting is prohibited) of the Turkish Central Hunting Commission (MAK). Other mammals of international note observed or reported in the study area and higher altitudes comprise gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), Eurasian badger (*Meles, meles*) and Alpine chamois (*Rupicapra rupicapra*) as well as a number of smaller mammals listed under Bern Convention and IUCN.

Yusufeli Dam site is located in the center of the Coruh Valley Wildlife Protection Area, which covers an area of 23,200 ha mountainous lands including sections of the Coruh and Oltu and Tortum rivers. The wildlife area was established for the protection of wild goats: Wild goat (*Capra aegagrus*) and Alpine chamois (*Rupicapra rupicapra*). Wild goats are also observed outside of the protected area. The main habitat of the wild goats is on both sides of these rivers at high altitudes. In the early morning they come down to rivers for drinking at various locations where human influence is rather low and topography is steep. These locations, are around the confluence of Oltu and Coruh (near the dam site), along Coruh River downstream of dam site (future Artvin reservoir), on locations in the upstream reach of the future reservoir, as well as on locations along Barhal, Oltu and Tortum Rivers. The riverine system in the valley (Coruh, Oltu, Barhal, Tortum rivers) forms a natural barrier and therefore sub-populations exist. These species live as flocks (about 10 to 20 members), in a territorial area, so they do not prefer to leave their territory and pass across the river. The protected area is managed by Artvin Directorate of Nature Conservation and National Parks. The population of wild goats in the region is presently estimated to be about 1,000 animals. It has recovered from some 350 animals in the year 2000 due to the strict ban on hunting, which is enforced by the gendarmerie and forest guards.

Birds: 79 bird species were identified in the study area, 33 of those non-passerines and 47 passerines. The species are also found in the Coruh River Valley, outside of the study area. And most are widespread in various regions in Turkey. About 60% are resident birds in Turkey, about 30% are summer visitors and the remaining 10% are winter visitors, and transit migratory birds. About 75% of the birds were found to be breeding in the study area.
A wide range of feeding and nesting habitats for raptors and small passerines exist in the area, from steep rocky cliffs to flat valley bed comprising river shorelines with trees, cultivated areas and near settlements (most of which are also by the river), shrubberies, natural and semi-natural meadows, degraded and natural forest areas, rocky areas with sparse trees and shrubs, and bare rocky slopes. Most birds identified in the area use more than one type of habitat. Raptors were only observed at higher terrain in mixed forests, rocky areas with sparse trees and shrubs and bare rocky areas. The Coruh River Valley in the project region, does not provide suitable habitats for water birds.

The raptors identified in the study area have the highest conservation status, all are on Annex 2 of Bern Convention, and also on Appendix 2 of CITES and Appendix 1 of the Turkish Central Hunting Commission. The resident Black vulture (*Aegypius monachus*), is classified as “lower risk: near threatened” (LR:nt) on the IUCN Red List.

Coruh River Valley is an on the migration route of many birds of prey. During fall, thousands of raptors of various species can be seen passing across the Coruh River Valley, which is along the north-south migration route of the birds of prey of the palearctic. The raptors however do not use the study area as “stop-over” during the fall migration. Rather, the raptors were observed to pass across the study area soaring at >1000 m ASL elevation.

Reptiles and Amphibians: 8 Reptile species (various snakes and lizards) were found throughout the study area. Only two amphibian species (marsh frog and green toad) were recorded in the river valley. All of the reptile and amphibian species identified in the study area are widespread either throughout Turkey or in eastern parts of Turkey. All are listed in Bern Annexes 2 or 3, but none in the IUCN Red Lists. All reptiles are protected by the Appendix 1 of the Turkish Central Hunting Commission.

Invertebrates: No invertebrate species of particular note were identified in the study area, the invertebrate population losses will not affect the species survival significantly as they are widespread in the region and as they are not bound to the reservoir area.

Fish: Mostly cyprinid fish were found in the study area (8 out of 11 fish species captured). Anatolian khramulya, Barbel, and Chub were determined to be the most dominant species in the study area. Only in the Barhal River salmonid fishes were found. This is due to relatively clear and fast running water as compared to the mainstream Coruh and other tributaries, which are turbid from suspended sediments. Except Black Sea salmon and the Brown trout, none of the identified fish are migratory. The brown trout travels to upper reaches of Barhal River it inhabits for breeding, while the Black Sea salmon migrates to the rivers flowing into the Black Sea for spawning. Muratli Project, which is the most downstream project in the Coruh River Development Plan is in operation since the end of June 2005. Thus, since the commencement of operation in Muratli Project, the upstream migration from the sea for the migratory species such as the Black Sea salmon on Coruh is blocked. Capture of Black Sea salmon (*Salmo trutta labrax*) is prohibited throughout the year by Turkish fishing regulations (period 2004 –06) which also limit fish capture for other species. Furthermore, fishing in the tributaries joining the Barhal River is prohibited. Danube bleak and Chub are on Annex 3 of the Bern Convention, while the Danube bleak and Carp are is classified as data deficient (DD) in the IUCN Red List.

III.3. Socio-economic Environment

Settlement Structure: The major settlement in the project area is the Yusufeli Town, which is the administrative center of the district, which will be inundated by the future reservoir. Within or in the vicinity of the future reservoir area further 19 villages are located, of which 3 (Kinalicam, Yenikoy and Irmakyani) will be completely inundated and the 16 others (Alanbasi, Arpacik, Bahceli, Bostanci, Celtikduzu, Cevreli, Cirali, Darica, Dereici, Ishan, Kilickaya, Kupluce, Morkaya, Pamukcular, Sebzeciler, and Tekkale) are affected either by partial loss of settlement or lands. Most settlements and their lands are located within the river valley, others are located on higher terrain and have lands in the valley. Villages connect to the main roads in the valley.

Demography: In general, there is a migration trend from the East Black Sea Region to bigger cities (Istanbul, Ankara, Izmir, etc.) due to limited economic opportunities prevailing in the region, as it is the case for Artvin Province. According to the official 2000 census, the population in all settlements by Yusufeli project of concern is 16,948. In the scope of RAP field studies for the Resettlement Action Plan (RAP) for the Project all households in Yusufeli town and the 19 villages were surveyed (total of 3,031 households: 951 from Yusufeli town, 2,080 from villages) were surveyed. The total number of residents recorded was 12,124[2].

The results of the studies showed that 22% of the surveyed population is younger than 15 years of age. About 65% of the people living in the study area are between the ages of 15 to 64, which is considered the economic active age group. Older people make up 13% of the population. The population in the project area has significantly less children and more old people when compared to the average for Turkey.

Infrastructure and Public Services: Since Yusufeli Town is the district center there is the governorship and relevant governmental offices in town. This also includes military units. Also the municipality and shops are located in the center of the town. In the study area there is only one state hospital, which is in Yusufeli district center. In addition, there is one doctor in Kilickaya. 3 high schools are in Yusufeli town and one in Kilickaya. Primary schools are in Yusufeli and in most villages. Morkaya, Sebzeciler and Cirali have no schools and pupils

[2] The notable difference in the 2000 census and the 2005 survey figures can be explained due to out-migration, over-aged population in the area, and census registration behavior of former residents who register with their home families in the project area.

have to attend school in other villages. In most of the villages there are shops, coffeehouses mosques and primary schools.

Road Communication: The major highways connecting the Artvin, Erzurum, Tortum, Yusufeli and Ispir towns are aligned presently along the Coruh River and its tributaries. These roads, which connect the settlements in inland regions to Artvin and hence to the Black Sea will be inundated with the realization of the proposed power plant projects on middle and lower Coruh River. Therefore, new highways are being planned and constructed to replace the present transportation network. Yusufeli Town is on the Artvin-Bayburt-Ispir state highway, which braches of from the Artvin-Erzurum state highway at the confluence of Oltu with Tortum.

Income and Sources: Family farming and subsistence cropping is dominant in Yusufeli District. In the study area, agriculture is the most common source of income in the villages, whereas for Yusufeli Town it is commercial activities and salaries for government employees and pension. Overall, agriculture and regular sources (salaries, wages and pension) form the most common sources of income in the study area (60% of the 3,031 surveyed households). The income distribution and income sources of local residents are presented in Table 1.

Table 1. Sources of Income and Income Distribution

Sources of Income	Yusufeli Town		Villages	
Type of Income	% of households	% of Income	% of households	% of Income
Salaries	25%	32%	11%	20%
Commerce and Trading	13%	29%	3%	5%
Pension	20%	15%	20%	24%
Wages	10%	7%	8%	11%
Agriculture	9%	4%	24%	16%
Livestocking	4%	2%	11%	6%
Income from Forest	<1%	<1%	<1%	<1%
Seasonal Works	2%	<1%	5%	5%
Other	17%	9%	18%	12%

Note: 108 households declared they would not have any income. It can be assumed that the majority of these live from subsistence food production on their plots in the villages.

The majority of rural people receive retirement pensions and salaries in return for civil service.

People living Yusufeli Town have higher income than the people living in the villages in average. The average income of households in Yusufeli Town is 1.45 times the overall average income of the surveyed settlements. The average household income in the study area is found to be about 6,000 US$/year. When the household size of four persons are considered, it can be found that per capita income in the study area is approximately 1,500 US$/year. This value is much lower than the average gross national income in Turkey, which is about 4,100 US$/year (DIE, 2005). In addition, the official minimum wage is 4,440 US$/year (Ministry of Labor and Social Security, 2005), which is higher than the gross national income. Comparing the income levels of different villages of concern significant income differences seem to exist among the villages.

The majority of households (87%) do not make enough money to save, whereas 31% of the households have debts.

There are five villages where more than 5 percent of household heads report working in the forest, which are Bahceli (17.29%), Bostanci (13.1%), Kupluce (4.6%), Pamukcular (5.39%) and Yenikoy (5%). Working in the forest (on a permanent or temporary basis) is not very high in the study area.

Industry is not developed in the region, except for the mining, dressing of minerals and lumber mills in the vicinity of Artvin. Large-scale factories do not exist in the Yusufeli District. Yusufeli Town has flour mills, macaroni plant, lumber mill, and automobile repair shop, which are all small-scale and two fuel stations.

Among the 8,825 people from all age groups that are not currently working, 14.5% is unemployed (age group 15-64).

Tourism and Recreation: In the project area and the vicinity there are no areas classified by the Ministry of Tourism as a 'touristic zone'. The Black Sea Region, including Artvin Province, has a considerable potential for tourism with its natural beauties, but the present geographic conditions, transportation and promotion means do not provide much support for this type of development. In the region, generally touristic facilities are located on the seashore. The mountainous area is suitable for climbing and trekking. The Barhal River and the reach of Coruh river from Ispir (in the upstream) to Sebzeciler (in the downstream of Yusufeli) is a well known rafting area (1993 world river sports championship was held on Coruh). In Yusufeli Town 2 rafting tour businesses are based.

Cultural Heritage: There are some historical monuments in the region, which comprises three citadels (Ogdem, Tekkale and Cevreli), two churches and a monastery (Barhal Church, Ishan Church and Dort Kilise Monastery. Only Tekkale Citadel is located inside the future reservoir, which will be relocated before impoundment.

Landscape: The landscape in the project area is dominated by the contrast of small scale agriculture in the Coruh valley bottom and the steep and barely vegetated slopes of the valley. Generally, along Coruh River agricultural areas are dominant in the valley bed, where forests are more seen along Barhal River, and along Oltu River barren lands are visible. Yusufeli Town is a typical small sized town of the North Anatolia located along the lower reach Barhal River above the confluence with the Coruh. The buildings are generally with three to four floors and the roads are narrow. Generally the architecture or materials of the buildings in Yusufeli do not reflect historic characteristics specific to the region but are modern times instead. In the study area typical characteristics of the Black Sea Region can be seen where settlements are rather scattered and remote. The buildings in the villages are generally of traditional style where both stone and wood is used. The study area provides for a number of vistas and landscape amenities: Along the Coruh River upstream of Yusufeli a patchwork of small scale fields can be viewed in the valley bottom. In addition, the man made stone terraces on the lower slopes are examples of traditional rural cultural landscape. Near Cevreli colored bare soils cover the slopes. The geological structure along Oltu River provides an exciting view where bare rock cliffs are steeply rising. Along the Barhal River pleasant natural landscape including forested slopes can be seen. Settlements on high elevations like Kilickaya and Ishan provide wide views into valleys. The project area is not located within a designated landscape protection zone at either a local or regional/national/international scale.

IV. ENVIRONMENTAL IMPACTS AND MITIGATION

IV.1. Physical Environment

Impact on Topography and Loss of Land

With the filling of the reservoir, the area upstream of the dam will be converted to a water body. The area of physical land take by the Project includes the reservoir area and the footprint of the construction sites and facilities (dam site, material borrow areas, camp facilities, access roads and relocation roads). The reservoir covers an area of 32.4 km^2 (710 m ASL.). Only a portion of the material borrow areas (0.5 km^2) is outside the reservoir. In addition, the staff accommodation and the Owner's camp facilities will be located outside the reservoir area cover about 0.04 km^2. The switchyard will cover an area of 0.03 km^2. The relocation roads are aligned above to the reservoir boundaries. The Artvin-Erzurum relocation road is 31 km long, while Artvin-Bayburt is 55 km long.

About one third of the impounded area is bare rocks and rocky terrain. One fourth is shrubs and steppe. Reservoir impoundment entails loss of 736 ha of land under agriculture and 129 ha of pastureland. Loss of forest is negligible. Reservoir Impoundment losses are presented in Table 2.

Table 2. Reservoir Impoundment Losses

Land use and Vegetation Cover	*Absolute Loss*	*Loss relative to reservoir area (32.4 km²)*
Agricultural Land	736 ha	23 %
Pasture Land	129 ha	4 %
Forests	10 ha	< 1%
Shrubs and Steppe	838 ha	26 %
Rocky Areas	1,034 ha	32 %
Water courses incl. alluvium and riverine vegetation	398 ha	12 %
Settlement and built-up area incl. infrastructure	100 ha	3 %

The areas chosen for the material borrow areas, which will not be inundated, consist of barren land. The areas for switchyard and owners camp facilities outside of the reservoir consist of semi-arid shrubs. The agricultural land loss due to relocation roads consists of approximately 0.25 km^2, while the area of pasturelands to be lost is about 0.03 km2 the remainder is mainly rocky areas.

Impacts on the Geological Underground

As the site has sufficiently firm geological characteristics, subsidence due to the weight of the reservoir water is not anticipated to be an issue of concern, neither is watertightness.

Triggering of strong earthquakes by the impoundment reservoir is considered unlikely based on the findings of the engineering studies. Project engineering design ensures that the effect of seismicity on the project during construction and operation is accounted for. Since there is no active fault system within the stress field of the dam, a catastrophic failure of the Yusufeli Dam, therefore, is unlikely. In any case, seismicity will be monitored by the measuring devices (strong motion accelerographs) installed in the dam and its foundation.

Slope Stability

Slope wash at the dam site is distributed at the feet of the slopes and along valleys, with a thickness of 3-4 m on the left bank, and basement rocks are exposed on most parts of both banks. Thus, it is not expected that construction activities would create any significant slope stability problems and landslides at the dam site. Additionally, during the construction of relocation roads shotcreting, netting, and rock bolting will be employed, where necessary to provide stability of the cut slopes.

No damage to the dam, blockage of the reservoir or a major flood wave within the reservoir is anticipated to occur in the case of collapse of slope wash after impoundment, since the majority of the volume of the two landslides in the reservoir area is located below the high water level and the slope wash on gentle slopes located above the high water level is generally thin.

Reservoir Sedimentation

The total sediment volume and the sediment level in the Yusufeli Reservoir are estimated as 514×10^6 m^3 and 636.0 m above sea level (ASL), respectively (EPDC, 1990). The minimum reservoir volume at the low water level is $1{,}070\times10^6$ m^3. Therefore, each year about 0.5% of the minimum reservoir volume will be filled with sediment, and after 100 years the total volume of sediment will reach half of the minimum reservoir volume. By the end of the 50-year economic life of the Yusufeli Project, about 25% of the minimum reservoir volume would be filled by sediment, reducing the storage capacity but not hindering power generation. Once the Upstream Arkun will be build within the mid-term future, sediment inflow into Yusufeli will be from it's own subcatchment below the Arkun catchment only.

Erosion in the Coruh Basin will be minimized by an afforestation program for the erosion control carried out by the General Directorate of Afforestation (based on a protocol with DSI). The works covers reforestation activities in 30,000 ha of land at a rate of 2,000 ha per year and commenced in September 2001.

Impacts on Soil

During construction, for the minimization of erosion at sites and sediment run-off to the rivers mitigation measures will be taken. These measures will be detailed and a site specifically developed Erosion and Sediment Control Plan will be prepared for each construction site. Stockpiles, including construction materials, such as concrete aggregates, filter material and sand will be properly handled and stockpiled separately from disposal areas, where surplus or waste excavated materials will be disposed. Additionally, topsoil from material borrow areas and from relocation roads will be stockpiled properly according to predefined conditions and as prescribed in the General Directorate of State Highways Technical Specifications on Landscaping Services and utilized for reforestation and implantation. Topsoil material will be salvaged to the extent possible to minimize loss through erosion. Appropriate cut-off ditches on the uphill side will be provided to prevent erosion in the disposal site and stockpiles. Moreover, The surface drainage systems will be used to direct the site runoff to settlement ponds before discharging to watercourses.

Impacts on Local Climate

Yusufeli Project will have a rather large reservoir but it is not expected that Yusufeli Reservoir, on its own, will lead to a significant change in the climate of the area. As the reservoir will store the energy from solar radiation received during summer in the upper water body and will slowly dissipate this stored heat during the winter, a general moderating effect

and trend to milder conditions resulting in increases in humidity and increased average winter temperatures and less hot conditions in summer can be expected. The effect of colder air from the slopes meeting the relatively warmer reservoir water surface will result in a tendency to mist and fog occurrence especially in winter. In the context of the Coruh cascade such layers of misty and foggy air above the reservoir surface possibly might float downstream into the subsequent reservoirs.

Global Warming Relevance

Greenhouse gas emission from Yusufeli Project is considered to be insignificant since about 50% of the inundation area consists of barren land and bare rocks and the remainder of the vegetation cover is very sparse and soil layers which store decayed biomass are also limited. When Yusufeli GHG emissions and global warming potential is compared with thermal power generation, the specific GHG emissions of Yusufeli is particularly advantageous since the power density (installed capacity/reservoir area) of Yusufeli will be 16.66 W/m². This value is significantly higher than those of other large HEPP's (Tucuruí, Brazil: 1.63 W/m², Ilisu, Turkey: 3,39W/m², Nam Theun II, Laos: 2,36 W/m² or Bakun, Malaysia: 3,45 W/m²). Assuming that the same annual electricity was produced by a modern, combined cycle, natural gas fired power station (CCGT), 682,000 tons CO_2/year would be released to the atmosphere. Thus, after 50 years 34.09 million tons CO_2 would be released. From the Yusufeli reservoir 1.24 million tons of CO_2 equivalent will be released after 50 years, i.e. less than 4% of the CO_2 emissions of a modern combined cycle power station and less than 2% of those from a modern lignite power plant.

Ambient Air Impact

Impacts on air quality are of concern only during the construction phase. The gaseous and particulate matter emissions during construction activities were estimated by modeling studies based on the provided construction schedule (detailing construction activities and their durations), construction work plan (detailing amounts of fills and excavations). Based on the model results, except for daily average PM, all the maximum values are well below allowable levels in Turkey. PM values might exceed allowable levels of the EU and might nearly reach the allowable short-term level in Turkey. Calculated values reflect worst case assumptions regarding the source adverse conditions Maximum values are expected near the earth-moving activities at material borrow sites, site preparation at dam site, excavation and fill activities, etc., but not near settlements. As the modeling did not take into account any mitigation measures to prevent or to minimize dust emissions from the construction sites and transport routes, the results point out that respective measures need to be taken. Within this context emissions and dust control plan will be implemented and the mitigation measures listed in Article 7 of the Turkish Air Pollution Control Regulation will be fully complied with. The preventive measures for dust control for construction related activities, including quarry sites, crushing and concrete batching plants, artworks including relocation road construction, embankment and tunnel construction, haulage of materials and construction work camps, includes use of water sprays, moistening and compaction of material stockpiles, covering of piled materials and trucks during material transport, following speed limits during transportation, use of tire wash for trucks. Additionally, the asphalt plant to be used during (relocation) road construction shall be equipped with dust filter and collectors and the equipment and the asphalt mixed debris will be swept, collected and taken back to the asphalt plant for reuse. Additionally, vehicles will be inspected regularly.

For the minimization of the dust and gaseous emissions from lower and middle Coruh transmission lines construction (380 kV and 154 kV projects) the mitigation measures and plans developed within the context of relevant EISs will be followed.

Based on the modeling results no significant dust nuisance is expected to occur in the present Yusufeli Town located at least half a kilometer away from the project site.

Noise Impact

The noise levels were estimated to be below the 70 dBA limit for construction works and 75 dBA limit for road construction works at the nearest settlements except in Cevreli and Tekkale villages. Noise levels exceed the maximum allowable in the villages of Tekkale and Cevreli; therefore corridors here was raised from 15 m to 35 m, at which distance the noise levels remain below the limit value set in the relevant Turkish regulation for noise.

Also, some levels (at Irmakyani and Arpacik) are rather close to the limit values. Due to the fact that the noise level estimations are based on a worst case scenario in which the set of machinery is assumed to operate at the same place and at the same time (that is in fact physically impossible), actual noise level are expected to be lower and within allowable limits.

To minimize burst noise, blasting in open excavations will be programmed for daylight hours using best practice for noise mitigation (i.e. use of electrical systems and delays to minimize generation of the audible fraction of air pressure waves). In order to avoid a startle effect at nearby settlements, blasting operations in open air will be carried out at dates and times to be announced in advance to the nearby settlement population.

For relocated Yusufeli Town noise generation and nuisance might be only of concern during preparation and construction of the site (excavation and filling, leveling and terracing for construction of the buildings and public infrastructure). The only settlement that would possibly be affected from such impacts is present Yusufeli Town. There are no other settlements in the close vicinity. Necessary precautions will be taken with regard to the noise levels of the construction equipment to be used and the Turkish Regulation on the Assessment and Management of the Environmental Noise will be complied with. Similarly for the minimization of noise generation during transmission line construction measures required by Turkish Regulations and detailed in the relevant EISs will be taken.

Impacts on Hydrology

Context of Downstream Projects:
By the time Yusufeli Dam is in it's second year of construction, Deriner Reservoir that ends below Artvin Dam will already be there in the downstream. Therefore, relevance of downstream effects from Yusufeli on the Coruh River channel and it's aquatic life is given for the 19 km of river between Yusufeli and Artvin dams until the filling of Artvin Dam. After that, not river channel will remain directly below Yusufeli.

Construction Impact:
For construction, the Coruh River will be diverted to two diversion tunnels via cofferdams to create a dry work area at the dam site. The natural flow pattern will not be affected by this.

Impoundment Impact:
The impoundment of the reservoir will be undertaken according to a detailed schedule, which will start 76 months after start of construction. Periods of technical measuring and monitoring are included as well as the wet test of the turbines. The duration of the filing process depends on the natural runoff dynamics and is assumed to be between 6 and 9 months.

During initial impoundment Coruh flow at the Yusufeli dam site will be stopped, which prevents continuous river flow in the downstream section. In order to prevent sections closest to the Yusufeli dam from drying a diversion pipe will be provided to continuously supply water

to the downstream and maintain continuous water flow at least to the level of a streamlet during this period. Until further impoundment has reached the power sill intake level, 5 – 8 m³/s water will be released to the downstream via the bottom outlet during 4 filling periods (39, 27, 13, 12 days duration). During the 3 in-between measuring and monitoring periods (7 days each) the natural inflow will be discharged. During wet test of Turbines 107 m³/s will be released. At the time planned for the wet tests to be carried out, the water released during the wet tests will already flow into the Artvin Reservoir since Artvin Dam is planned to be completed simultaneously with Yusufeli Dam. For the case that Artvin Dam would not be in place as scheduled at the same time as Yusufeli Dam, it is estimated that even in maximum discharge conditions during wet tests no flooding impact due to downstream water release is estimated (by model calculations) to occur at the settlements, agricultural lands, or roads located downstream of Yusufeli Reservoir.

Operation Impact:
The downstream discharge of Yusufeli Reservoir will be daily fluctuating according to the peaking operation pattern. The maximum discharge through all three turbines will be 321 m^3/sec. For the case that Artvin Dam is built as scheduled, discharge will reach the Artvin Reservoir with an elevation of 500 m ASL. The effect on hydraulic characteristics on the upper reach of Artvin Reservoir will be insignificant.

In the case that construction of Artvin Dam was delayed the downstream section of Yusufeli would remain as a river section above minimum operational level of Deriner Reservoir (about 28 km downstream of Yusufeli Dam). At this section, the interrelation of reduced sediment supply and frequent intensive flow pulses will cause a gradual reduction and frequent disturbance of gravel banks and point bars. The main character of the most hydraulically exposed channel structure will still be the stable bed formed by coarse boulders and bedrock.

Based on the hydraulic modeling study results, even when all three turbine units operate at the same time the discharge flow will be 321 m^3/sec, which is much lower than the average peak flows in May (about 395 m^3/sec), the change of the flow regime due to operation of the Yusufeli Project will not adversely affect the settlements downstream. Additionally, the road access of all inhabited locations between Yusufeli and Artvin dam sites will not be impacted by Yusufeli hydropower operation until Artvin Dam is built. Also, the water level will be adequate for further water use downstream from Coruh Stream for irrigational purposes for the only greenhouse obtaining irrigation water from the river. With regard to ecological water dependencies, there is already not much vegetation in the drawdown zone of the river and the limited vegetation along this zone is subject to natural water fluctuations.

The main concern with respect to downstream conditions until Artvin Dam is built is water deficit. Therefore, a minimum flow of 30 m^3/sec ($Q_{7,10}$: 22 m^3/sec and with statistical analysis for 90% and 84% exceedance of this values, 30 m^3/sec minimum flow was found to be safe to provide to downstream) will be provided downstream for the riverine environment for all times when there is no flow through the turbines. Given the relatively good water quality conditions in the middle section of the Coruh River, this flow is considered to be sufficient to maintain the existing waste assimilative capacity and aquatic life in the downstream section of the Project during operation.

Sediment Trapping and Downstream Impacts

The suspended sediment amounts measured on Coruh River indicate that about 83% of the total suspended sediment (6.22 million ton/year) carried by Coruh River to its mouth will be trapped by the Coruh Cascade up to Muratli Dam. With the opening of Muratli Dam (first dam of the Coruh Cascade) in June 2005, a process started where sediments are held back

on the Turkish side and are not further transported down the Coruh into Georgia. On the Lower Coruh, Deriner that will start operating in 2007 will have the largest sediment trapping effect. Deriner will have the capacity of holding back all of the suspended sediments that may originate from upstream catchment area. The sediment trapping in Yusufeli is only 0.28% of the whole annual yield of 7.49 million tons/year reaching the river mouth, which shows that Yusufeli will not cause significant impacts of it's own to the downstream. The effect of the Middle Coruh section (Yusufeli and Artvin projects) on sediment retention is only 0.3% of the total.

Trapping of 83 % of the suspended sediments in Coruh Cascade might create changes in the river mouth. Presently the Coruh mouth is moderately delta shaped. The trapping of sediments in reservoirs is known to have the potential to cause significant effects on river deltas, especially when the dam is the first on that river. With reduced sediments arriving, gradually the mouth of the Coruh may morphologically transform towards an estuary shape. However, the formation of morphodynamic processes and their dynamic interactions and consequences are very difficult to predict. In order to approach these issue, since 1996, Turkey and Georgia have agreed on and implemented survey and monitoring work on the Coruh River incl. the Georgian river section, the Coruh mouth and the Black Sea coastline up to Batumi in order to establish a status quo documentation, and to further monitor changes which may occur after implementation of the dams on the Turkish side. Between the two parties it was agreed that for the case that considerable change of the coastline should occur, the reason for this will be investigated jointly by the technical experts of both sides. If it should be found that this change was produced by the construction of dams on the Coruh River on the Turkish territory, related governmental authorities will be informed accordingly to agree on required coastal protection measures.

With respect to the possible relevance of potential impacts on sensitive areas, regarding the actual status of the reach towards the delta it can be said that no protected areas have been established in the lower reach of the Coruh. There are studies of the Georgian Authorities with regard to Coruh Delta to put the area under protection as a nature conservation area. It should be noted that there are already major structures in the vicinity of the Coruh Delta, such as the Batumi airport to the east of the river mouth.

Impacts on the Yusufeli Reservoir from Future Upstream Projects

The projects that are planned to be constructed upstream of the reservoir (Arkun is the first project upstream) will detain the sediments from reaching Yusufeli reservoir and the sediment to be held in Yusufeli Reservoir will decrease. Additionally, hydrodynamic conditions of the Yusufeli Reservoir inflow will be impacted by upstream reservoirs. Based on the hydrodynamic simulation study, it is estimated that stabilized inflow temperature from Arkun into the Yusufeli reservoir combined with the impact of the water storage volume acting as a thermic buffer and a heat trap further reduce the fluctuations in the Yusufeli outflow temperature. The downstream temperature levels are estimated to be similar to the temperature levels for the average operating conditions, however monthly average minimum is increasing slightly above 10 degrees Celsius. The fluctuations of the water temperature within the reservoir resulting from varying inflow temperatures before implementation of Arkun is expected to disappear with temperature stabilized inflow from Arkun dam.

Impacts on Water Use

River water will be used for the project during the construction phase for process and domestic purposes. The domestic uses of water will continue during the operation phase as well, but the amount would be much less since the number of employers at that stage would be about 100. Total amount of water that will be used in construction phase will be around

9,100 m^3/day (about 0.09% of the annual flow at the project site). The wastewater streams from project facilities will be discharged after proper treatment required by relevant Turkish Regulations and complying with international standards. There will be no significant impact on hydrology, resulting from the water consumption as process and potable water during the construction phase, or the domestic water use in the operation phase. During operation there will be no significant abstraction of water from the reservoir such as for irrigation purposes.

Waste Water discharge from Settlements

During the construction of the relocation site drainage and treatment facilities (sediment traps, stilling basins, etc.) will be provided for surface runoff and runoff from any construction activities, such as concrete mixing. After resettlement of project-impacted settlements approximately 23 L/sec (2,000 m^3/day) is estimated to be produced at new Yusufeli Town. This amount will be collected by a sewage system and treated in a new biological wastewater treatment plant. The treated effluent complying with the Turkish Water Pollution Control Regulation and Water Products Control Regulation will be discharged to the reservoir. From the resettled rural areas, it is estimated that approximately 7 L/sec (572 m^3/day) will be produced. The wastewater from the rural areas will be discharged to septic tanks that will be built in new rural resettlement sites.

Impacts on River based Tourism, Sports and Recreation

Most of this river reaches that are currently used as rafting area will be inundated by the Yusufeli Reservoir and the downstream projects. Since the Yusufeli Dam is not planned to be operated as a constant level reservoir, recreational activities along the reservoir shores and in reservoir is not considered to be possible in larger scales or as continuous operations. Summer season, when the reservoir is operated at the high water surface elevation, is considered to be most appropriate for recreational activities on the reservoir.

Reservoir Productivity in Terms of Fisheries

The composition and quantity of the potential fish stocks in the reservoir will not be sufficient for commercial fisheries or good sport fishing. However, in the case that introduction of some fish species to the reservoir is applied, as an implication observed in similar projects, an ecological monitoring program is required to be applied for the protection of sensitive species and the growth pattern of the fish species and species distribution within the reservoir. Also for the case that commercial fish farming (e.g. by floating net cages and daily feeding) is considered, ecological monitoring would be necessary as increased nutrient input and detritus, etc. would impact water quality.

Impacts on Water Quality

Impacts of Project Construction:

The in-river construction activities, including the activities in some of the borrow areas, in dam projects unavoidably but temporarily will increase the turbidity in the downstream waters. Wastewaters from concrete operations could also affect the alkalinity of the water with their high pH level. For Yusufeli Project, basically clarification and neutralization will be applied to prevent such water pollution in the construction phase. If it is assumed that all the water used as process water turns into wastewater, the amount of this wastewater will be about 8,500 m^3/day (or 0.1 m^3/sec). The effluent from the neutralization and clarification units where the process water used for the concrete operations will be treated onsite and will be discharged in compliance with Water Pollution Control Regulation and Regulation on Water

Products Control Regulation. The same applies to the domestic wastewaters from camp sites etc., which will be treated with an onsite treatment plant.

For the protection of the water quality at the construction sites, a wastewater management plan will be implemented. During the road construction, drainage facilities will be provided with stilling pools to trap any sediments carried with surface runoff as well as runoff from any in-situ concrete mixing activities.

Impacts of Impoundment and Operation:

Thermal Stratification and Eutrophication in Reservoir

The thermal conditions and water quality for the reservoir was modeled. The temperature profiles for all of the scenarios run for 10-year period indicate that the reservoir will be stratified most of the time during operation period. However, the stratification is estimated to either disappear or lessen significantly in late winter - early spring that will enable complete or partial mixing through the water column from different locations of the reservoir for different operational conditions.

The water quality impact of suspended materials during impoundment and the decay of biomass including soils left in the reservoir were modeled. As natural nutrient inflow is low and present biomass in the future is also low due to the relatively scarce vegetation and soil cover no critical conditions in terms of oxygen depletion, euthropication and the like are anticipated based on modeling results. Moreover, harvesting of the fields in the reservoir area before impounding will reduce the biomass to be left in the reservoir. The villagers will be informed about the commencement date of impounding in advance and they will have a chance to harvest their products. The villagers will also be allowed to cut and collect the trees in the reservoir area, which will allow the clearance of the vegetation cover in the Yusufeli reservoir area to some extent. Remaining forest vegetation will be cleared by the forest administration.

Based on the modeling of reservoir water quality and relevant ecological parameters, it is estimated that the reservoir will have N-limited growth conditions with low primary productivity levels and overall oligotrophic state. Due to the low trophic level and poor nutrient inflow to the DO levels in the reservoir will be sufficient to sustain fish life above 560 m ASL.

Reservoir Downstream Water Quality

The reservoir will function as a heat trap and thermic buffer limiting intense temperature fluctuations throughout the year, moderating seasonal changes in inflow and ambient air temperature preventing extreme seasonal or monthly fluctuations in the outflow water temperature. Moreover, the downstream water release is provided by the HEPP's outflow, i.e. from the upper layers of the impounded water body, and occasionally mixed with surface water from the spillway overflow. Therefore, particularly for the conditions that minimize discharge through the spillway that results in slightly increased downstream water temperature levels compared to the baseline temperature levels. The simulation results for average discharge conditions show that the minimum downstream water temperature is estimated to increase from 2^{o}C to 9^{o}C and the maximum downstream water temperature is estimated to decrease from 21^{o}C to 17^{o}C with an approximate 3^{o}C increase in the average downstream water temperature in average (from 9^{o}C to 12^{o}C).

The reservoir is expected to have a slightly positive impact on the downstream water quality, creating a decrease in the concentrations of NH_4-N, NO_3-N, and PO_4-P parameters. Comparison of the average concentrations of these chemical parameters with the Turkish Water Pollution Control Regulation (WPCR), Inland Water Resources Classification Criteria, indicates that at present the watercourse downstream of the dam site can be classified as Class II water resource.

Oxygen concentration in the released water is expected to be between 9-10 mg/L i.e. similar to the present baseline DO levels (8-12 mg/L). Even the minimum DO concentration estimated for the Reservoir downstream is sufficient to sustain appropriate habitat for growth of fish and larvae, and spawning.

Sanitary Risk

Considering similar projects, bacterial diseases (such as diarrhea) are not expected to develop or spread as a result of the impoundment. Additionally, any effluent discharged to the reservoir will be treated in compliance with the Water pollution Control Regulation and Water Products Control Regulation. Therefore, the Yusufeli Project will not impose any increased risk to human health.

Waste Management Plan covering Solid Waste and Spoil Management Plan, Hazardous Waste Management Plan will be implemented during the project activities.

The wastes generated during construction phase will be managed according to Turkish Solid Waste Control Regulation (TSWCR), and internationally accepted standards. Separate waste containers will be provided for different types of wastes and no waste will be disposed of or buried on the site. Illegal dumping, either at the construction camp, along public roads or in the surrounding areas, or into the river will not be allowed.

During operation the wastes generated from hydropower plant operation will be managed according to the Turkish Solid Waste Control Regulation (TSWCR). Solid wastes to be generated during operation will be mainly domestic wastes and some hazardous wastes, mainly machine oils and fuels. To handle these wastes properly during operation relevant provisions of Solid Waste and Hazardous Waste Management plans prepared for construction wastes will be implemented. The domestic wastes will be disposed to the landfill of new Yusufeli Town. The other wastes including any hazardous waste will be temporarily stored and contractors licensed and certified by the Ministry of Environment and Forestry will be commissioned for safe handling, treatment, and disposal of these wastes.

Solid wastes that will be produced in the new district center will be collected by the municipality. The municipality will dispose these wastes to a new landfill in accordance with TSWCR. According to this regulation leachate collection and treatment will be performed. Thus, there will be no discharge of untreated leachate into the reservoir. The layout of this disposal site and its location will be dealt with in the further detailing of the planning for the new town.

IV.2. Impacts on Biological Environment

Impacts on Flora and Vegetation Communities

The flora and vegetation in the area will be mainly affected due to land take and impoundment of the reservoir, and to a rather less extent from operation. In the footprint areas of construction and impoundment area all of the vegetation population will be lost.

Agricultural lands forms 20% of the reservoir area, while pastureland and fallow areas cover about 6.5%. Forests cover 0.3% of the reservoir area. The rocky areas cover 33% and the shrubs 25% of the reservoir area. The areas chosen for the material borrow areas, which will not be inundated, consist of barren land. The areas for construction facilities consist of semi-arid shrubs. The agricultural land loss due to relocation roads consists of approximately 0.25 km^2, while the area of pasturelands to be lost is about 0.03 km^2.

The type of natural vegetation to be most significantly affected due to inundation is riverine vegetation, which is found in the valley bed mainly along Coruh mainly. Especially 75% of the black alder-willow communities determined in the study area (up to 1,000 m ASL) will be lost. Also areas covered by water, alluvium and settlements would be lost. However, some riverine vegetation is still available above 710 m and is found on the upstream sections of the river reaches, and along small tributaries of these rivers, that will not be inundated by the Yusufeli reservoir.

Although part of the populations of the flora species within the study area are located below 710 m ASL and therefore will be lost with water impoundment in the Yusufeli Reservoir, there are other populations within the study area above the 710 m elevation as well as populations along Ogdem road at an elevation of about 1000 m and populations in the vicinity of Tortum Lake outside of the study area.

The populations of protected flora species are homogenously distributed below and above the future reservoir line, and the areas where these species are observed (i.e. the populations) are significantly larger above the 710 m ASL, which is the water level in the future Yusufeli Reservoir. Although the populations within the reservoir area will be lost by inundation, none of the endemic species will be completely lost from the vicinity of the project area and the populations of all the endemics are found to be sufficiently large enough to be sustainable such that their survival is not under threat by the realization of the Yusufeli Project.

Xerophyte shrubs and chasmophytes (woundwort, corn flower and knapweed communities) on rocky areas are the main vegetation communities that exist within the 720 to 750 meters (Artvin – Erzurum Relocation section is more or less along the 720 m contour) elevation range of the corridor of the new roads along the reservoir. Therefore the impact of relocation roads on flora is considered to be insignificant.

Transmission line construction impacts on flora are assessed and relevant mitigation measures were developed within the scope of relevant EIA studies. For the conservation of flora measures in the related EISs will be followed.

Impacts on Fauna

Terrestrial Habitats:
Terrestrial fauna in the area will be affected through disturbance from construction activities, land take and habitat loss through the reservoir impoundment due to the loss of the vegetative cover. Since the population of faunal elements in the nearby areas is not very dense, the species escaping from the reservoir area and construction sites will not stress the surrounding habitats. Similar to impacts on flora impacts on fauna due to construction of transmission lines are assessed within the scope of relevant EIA studies. Proper mitigation measures will be taken during construction as detailed in the related EISs.

Mammals:
The project realization will result in a totally 1,460 ha to be lost in a central location of the Coruh Valley Wildlife Protection Area of 23,200 ha. The loss due to the reservoir comprises the valley bed and steep slopes. As the Coruh River is already forming a barrier for the goat

populations, the Yusufeli Reservoir will not lead to effects such as isolation of populations, which might endanger the survival of the species.

With regard to drinking needs, when construction activities start it is anticipated that daily migration routes of the wild goats will change and they will prefer the sections with less disturbance, such as downstream of the dam site on Coruh River, upstream sections of the Barhal River, and the tributaries (i.e. Tekkale Creek). During operation, goats would be able to drink from the reservoir as well as from the small tributaries that are not inundated. The goats are used to steep topography, so in many sections drinking from the reservoir is not considered to be a problem for the goats. However, the new relocation roads would form a barrier especially in sections where retaining walls need to be used. In addition, during the operation of the roads there may be a risk of collision when goats are coming to water before dawn. Driving speeds due to the frequent curves on the new relocation roads will be relatively low (60 km/h), however the curves also cause late recognition of animals on the road. In order to reduce collision risks drivers will be warned of potential fauna crossings, by warning signs (deer sign indicating wildlife), which will be put on the highways on relevant sections in coordination with Artvin Directorate of Nature Conservation and National Parks. Furthermore, project traffic will be limited to designated roads. Additionally, during construction, the Consortium will set-out rules for the workers regarding the prohibition of hunting as well. Wild goat and Alpine chamois will be protected by prohibition of hunting in the area and is being controlled by forest guards and the gendarme. Workers will be instructed to report any sighting of wild goats to the environmental site manager. In addition to these, the construction sites will be secured by temporary fencing, which will also prevent the entrance of wildlife into these areas. In order to provide passageways some of the box culverts (2m x 2m) built into the base of the new roads to provide for drainage run-off from the slopes and from the road will be built with larger cross-section (3m x 3m) as to provide under-passage for the wild animals. Locations will be determined in consultation with the Protection Area administration. The EMP sets out mitigation measures including a wild goat management plan in order to monitor and manage wildlife issues and the potential adverse impacts.

Three mammalian species identified at the site, pygmy shrew (*Sorex minutus*), forest dormouse (*Dryomys nitedula*) and hedgehog (*Erinaceus concolor*) will loose their habitats that they depend on. The first two species may not be able to find similar habitats to escape, which may cause loss of the population living in the area. Hedgehogs in the project area will have a much better chance to survive, since shrubby vegetation is widespread above the reservoir normal water level. Hedgehog and forest dormouse is widespread in all over Turkey, while pygmy shrew is widespread in Marmara Region and north Anatolia. Therefore, it can be concluded that these species do not have significant threatening status and the impacts of the project on their survival would be insignificant. Moreover, no significant impacts are expected for other mammal species either, since they are not dependent only on the river habitat in the valley bottom or cultivated areas. Besides for measures for the wild goats, there is no need for any particular mitigation measures for mammal species identified in the reservoir area, or at any of the construction sites, along the relocation roads or the material sites.

Birds:

Based on the surveys there are no bird species that breed only below 710 m ASL. All of the species that use the habitats below 710 m for breeding also use habitats between 710 to 1,000 m, while 75% of these species use even above 1,000 m for this purpose. Therefore, no breeding species would lose the only habitat they use for breeding.

The species that use these habitats for feeding, breeding and/or traversing will lose their habitat. Although these species can find adequate habitats upstream of the reservoir on Coruh, Barhal, Oltu and Tortum rivers the Coruh River Development Plan that comprise construction of additional upstream dams will cause reduction of habitats in the vicinity. This may result in a decrease in population of species.

Reptiles and Amphibians:
Depending on the time and duration of impounding the populations of reptile and amphibian species living below 710 m elevation will be lost due to impounding if the period of impounding is between fall and spring months, since these species would be become less active and very unlikely for being capable of escaping during their hibernation period that lasts till spring. However, due to the fact that all of the reptile and amphibian species at the site are widely distributed the losses will not be significant in terms of species conservation.

Invertebrates:
Due to inundation especially the riverine habitats will be lost, which may cause the loss of the existing populations of the invertebrates in this area. However, none of the identified invertebrate species are included in any category of the IUCN Red List or annexes of the Bern Convention and therefore require particular protection measures.

Fish:
During construction the population of fish species might be affected to an extent, but construction impacts will be temporary and there are sufficient habitats in the Coruh River both down and upstream and its reaches for the fish species to survive. Due to the possible partial loss of population of some of fish species the impact of construction on the populations would be significant. The species would escape to tributaries of the river in the case of any changes in water quality (turbidity, pH, etc.) or in the case of improper hydraulics particularly at the immediate downstream of the reservoir such as very high or low flowrate levels especially during impoundment. These tributaries in the downstream provide suitable habitats for the fish species to sustain.

Based on the reservoir hydrodynamic and ecological modeling studies, during operation of the reservoir the annual cycle of thermal stratification and mixing as well as the plunging tributaries provide a wide range of temperature levels appropriate for different fish species at different life stages. Furthermore, the preponderant part of the reservoir water body will be suitable as a living and breeding habitat for the fish species with respect to DO and temperature. Additionally, no adverse impacts by ammonia are expected in the reservoir in the long term. It is estimated that, due to the N limitation and the short residence time, the low productivity at the primary level of the foodweb is estimated within the Yusufeli reservoir, which might lead in limitation of potential density of fish stocks.

It is considered that downstream water temperature will be directly related to the reservoir mode of operation, which creates modifications of the natural seasonal changes of water temperature. This impact is not considered to be significant for spawning of fish species other than salmonids since the spawning of fish is mainly dependent on the water temperature. Fish are known to be able to delay their spawning and store their eggs in their body until they found an adequate water temperature for laying their eggs. Therefore, spawning might occur whenever proper temperature range is reached. For salmonids (*Salmo trutta labrax*) the migration on Coruh River is already blocked by the implementation of downstream dams, therefore the change in the downstream water temperature will not be relevant for this fish group.

DO level at the downstream of the reservoir is estimated satisfy the imperative standards required by EU Freshwater Fish Directive. The critical values in Freshwater Fish Directive defined for temperature increase at the downstream of the reservoir is also satisfied during

the reservoir operation. The maximum allowable temperature levels defined as imperative standards for Salmonid and Cyprinid species are satisfied 100 % of the time during entire operation. The maximum temperature level standard for breeding season of salmonids and cyprinids can be achieved during December, January, February, and March. However, the combined operation of Yusufeli Dam with upstream Arkun Dam is estimated to impact on the downstream water temperature levels in that it will cause the minimum downstream water temperature level to increase above 10 C^o.

Observing downstream maximum and average concentrations, NH_4-N level is estimated to be well below the critical concentrations. Nitrite levels are also not expected to create problems for downstream fish life.

The development of the Yusufeli Project will result in a change in the composition of aquatic species in the project area. Fish species preferring riverine habitats will migrate to upstream reaches of Coruh and tributaries. Composition of plankton and benthos communities will also change from that of the river to that of a lacustrine environment. The population of the migratory fish species (*Salmo trutta*) is estimated to be negatively impacted by the construction of the reservoir on Coruh Reservoir forming a physical barrier on their migration route. Formation of the Coruh Cascade will cause the Coruh river system to be inappropriate as a living and breeding habitat for migrating Salmonid species.

Since species such as carp, barbel, chub etc. can well adapt to lake environment, their dominance fraction in the future Yusufeli Reservoir can be expected to increase. The presently available spawning habitats will be reduced by the loss of riverine conditions. However, these species in Yusufeli Reservoir can migrate to suitable spawning sites upstream of the reservoir in the unflooded sections of Barhal, Oltu and Tortum rivers and other smaller tributaries. Therefore, they are not considered to be significantly affected from the Yusufeli Project. However, a future increase in environmental stresses on fish species such as depletion of food sources, and spawning habitats as the result of combined or cumulative impact of several factors might result in a proportional decrease in the long run. DSI will monitor the fish life after the formation of the Artvin Reservoir and if depletion is found a restock with fish species will be made.

Based on the reservoir downstream hydraulics study the discharge rate from the reservoir creating a shear stress at the downstream of the reservoir will cause gravel and boulders with relatively smaller in size to be transferred downstream changing the downstream habitat conditions that is important for spawning. However, this impact will decrease significantly, on the condition that the construction and operation of Artvin Reservoir is realized without delay and the Yusufeli Reservoir is operated in combination with downstream Artvin Dam. The fish community of Artvin reservoir will be formed by that species from Coruh River that tolerate a wide range of flow velocities.

Significant impacts are expected if a delay in Artvin dam's completion lasts over one reproduction period. Peaking hydropower operation scheme with daily intermittent zero downstream release will create main disturbance. For this scenario, a minimum downstream discharge of 30 m^3/sec (based on the $Q_{7,10}$ of 22 m^3/sec) will be supplied to sustain aquatic life. If it should become foreseeable that a delay lasts for more than one year, a detailed ecological study on optimized downstream water supply will be in the responsibility of DSI and the results should be implemented in the reservoir's operation scheme.

IV.3. Impacts on Socio-Economic Environment

Impact on Settlement Structure

Yusufeli Town and Kinalicam, Yenikoy and Irmakyani Villages will be completely inundated by the future Yusufeli Reservoir. Moreover, Celtikduzu and Tekkale Villages will loose houses and the majority of their agricultural lands, and Sebzeciler Village will be affected from the dam construction site and concrete facilities. The physical loss of this village due to Yusufeli Reservoir would be rather small (0.09 ha). However, the results of the RAP surveys based on the answers of the villagers to the questionnaires reveal that the villagers are losing significant amount of property due to Artvin-Bayburt relocation road construction facilities. It should be noted that, Sebzeciler Village will lose their lands mainly due to the future Artvin Reservoir .

Tekkale and Cevreli will beside losses from impoundment be also affected from the alignment of the relocation roads (possibly few houses depending on detailed road planning, and agricultural lands).

Land take from expropriation will be approximately 167 ha for the Artvin-Erzurum relocation section and 198 ha for the Artvin-Bayburt relocation section. Moreover, agricultural land will be expropriated or at times left in a situation where cultivation will be difficult. Impacts on settlements will be such that a number of houses on the road alignment will be resettled. Resettlement will also be imminent for those houses, which are downslope of the alignment corridor, given that road construction may result in rockfall and pose dangers for the houses.

The inundation of the present Yusufeli Town, which is the district center, requires the reestablishment of a new district center. This is planned to be developed at Yansiticilar site (urban relocation site) on an area of approximately 175 ha and located at less than 1 km distance to the outskirts Yusufeli Town in the western direction. The area to be used for this site is treasury land composed almost completely of bare land and shrubs with no settlements and human activities in the area. Yansiticilar site is rather close to the present Yusufeli Town and will have the same functions, since it will continue to be the District Center and will have the same central location in the district. For rural resettlement candidate sites, generally close to the villages to be resettled at higher elevations, are identified during the RAP studies and technical evaluation of these sites will be made by the Ministry of Public Works and Settlements.

Impacts on Population

The Yusufeli Dam and Hydroelectric Power Plant is a development project that will entail involuntary population displacement; this will include both physical and economic displacement. The project-affected population consists of people living in Yusufeli district center and 19 villages.

The number of households to be displaced due the physical losses caused by the Yusufeli Project is found to be 1,888 as a result of the RAP studies (ENCON, 2006). Thus, the number of project-affected persons (PAPs) (affected completely or partially) from the project is 10,883. The groups and categories of affected people were identified and presented in detail in the RAP report and the specific impacts for each group and their entitlements to compensation and resettlement were determined. For socioeconomic conditions and resettlement issues resettlement action planning (RAP) studies have been carried out. Details of these are provided in the RAP report together with necessary mitigation measures (including minimization and compensation) for the impacts on physically and economically displaced people. With this regard, expropriation compensation and government assisted resettlement opportunities will be provided to the entitled population.

Impacts on Employment

Among the population that is already employed, including the retired people, the ones working in agriculture sector are the main ones under risk regarding employment after the realization of the project basically due to loss of agricultural land. If these people choose rural resettlement, depending on the land that can be provided to these persons by the government, they may not be significantly affected from the project in means of employment. However, if they choose urban resettlement they may have problems regarding employment chances. This may not be only due to the qualifications of these people, but also due to the present rate of unemployment in the area.

A possible positive effect of the Yusufeli Project might be the provision of employment for the people in the region. Consortium will provide training and employ local people as construction workers. Additionally, for operation activities that do not require high skills or special training, local residents would be hired and trained.

In the view of project implementation Artvin Governorate has already organized and conducted training courses in summer 2005 to improve the skills of locals that can work in the construction. The Consortium provided a list to the Governorate that indicated the number and skill degree of workers, which will be needed during the construction period of Yusufeli Project. These measures will aim to provide equal opportunities for the resettlers in finding new jobs eliminating disadvantages that might be created due to low education level. Furthermore, the new Yusufeli Town will provide work opportunities at least at the same level as the present Yusufeli Town, based on its functioning as the district center.

Overall the employment opportunities during construction may be considered as temporary, however they are planned to last almost eight years and will provide midterm economic opportunities for the local population.

Impacts on Social Interactions

As a result of different choices, such as expropriation, urban and rural resettlement, the villagers might have to be separated from their relatives and friends. Such a disassociation and dispersion of villagers would cause the ties of solidarity and dependency to diminish. This in turn will result in a lack of support from friends and relatives. If the affected persons in a village are resettled together, the problems that they may face with regard to social interactions will be minimized. Otherwise, the issues mentioned above would be of concern for especially the ones that will leave the area. The location of the new district center is very close to the present district center, so most of the ties established in Yusufeli Town till present could continue.

Impacts of the Project in Terms of Living Standards

The adverse impacts on livelihood are associated mainly with land acquisition, and displacement. Direct impacts on their livelihoods involve the loss of the homestead and land and particularly loss of agricultural lands.

In the case of urban resettlement, the likelihood of finding employment and/or income for women, and elderly people, who do not have any skills will be quite weak. This may cause a decline in their standard of living and level of income. Thus it is essential to implement programs for the adaptation of the latter. These programs will include trainings, educations, and provision of credits (details are given in RAP Report). By explaining the pros and cons of urban and rural resettlements in detail via consultation and participation studies it will be ensured that these groups make their selections on a well-informed basis. However, the

active population living in Yusufeli Town is mainly employed in social and public services sector and these may have better employment opportunities in case of urban resettlement.

Furthermore, the resettlement areas will be constructed, including all infrastructure (environmental and other), before impoundment.
The details of the schedule and the measures to be taken as mitigation will be provided in detail in the RAP report.

Impacts on Host Population

The new district center will be established at the location called Yansiticilar and Sakut Creek. This is located very close to the present Yusufeli district center (less than 1 km distance to the outskirts Yusufeli Town in the western direction). Therefore, most of the Project Affected People preferring urban resettlement are expected to resettle in the new district center. Yansiticilar and Sakut Creek Site will cover an area of approximately 175 ha which belongs to the Treasury. At the site currently, there is no host population, which might be affected due to the project since the selected relocation site is at present an undeveloped area with no settlements on it and which is not used for any income earning activities. This is also an advantage when the previously considered relocation sites Kilickaya and Ishan were compared to the selected Yansiticilar and Sakut Creek site.

Impacts on the Transportation Network

The realization of the proposed development of the middle and lower Coruh River Basin, will inundate main highways in the valley including the present Artvin-Erzurum state highway connecting the settlements, such as Artvin, Erzurum, Tortum, Yusufeli and Ispir, which are located along the Coruh River and its tributaries, beginning from Borcka District. The 31-km long Artvin-Erzurum and 55-km long Artvin Bayburt relocation roads will be built in the scope of the project to replace the road connection, which will be inundated. Additionally, necessary measures will be taken to facilitate the connection of the roads to the villages and hamlets that are close by.

As the new district center still remains in a central location the general spatial relationships in road connection remain the same. With the selection of the relocation site at Yansiticilar, a bridge was planned to be constructed to connect the western and eastern sites of the Barhal Valley. By this bridge travel from the eastern site of the future reservoir to the new Yusufeli Town will be by about 17 km shortened as compared to driving along the reservoir reach reaching up to the Barhal River. However some longer travel distances on the road relation to the new district center occurs on the settlements located on the southern shore of the reservoir. To the southwest this effects apply to Kilickaya (13 km longer route to Yusufeli) and Celtikduzu (23 km). To the east, the settlements located along Oltu and Tortum Rivers, Morkaya (27 km), Arpacik (17 km) and Darica (8km) villages are affected by a relatively long detour. For other villages the increase in travel distances is between 1 and 9 km.

Impacts on Landscape

There will be visual disturbance during the construction phase of the project due to quarry operations, relocation road construction and possible obstruction of views at some construction areas, basically dam site. Visual impact due to construction will be temporary and locally significant.

Construction sites and the borrow area outside inundated lands will be restored and landscaped after the completion of construction.

The relocation roads follow a contour and are therefore to pose minimal impact on scenery. After construction of the new roads landscaping measures will be applied according to General Directorate of State Highways Technical Specifications on Landscaping Services. Revegetation, stabilization of slopes, etc., shall be conducted according to the structural and vegetative landscaping projects yet to be devised for this stage of the project. In addition, landscaping will be done to improve visual amenity where the roads pass through the settlements.

The Project will result in a permanent change in the landscape character of the area principally changing the topography as a result of the formation of a reservoir. Water bodies, such as lakes or reservoirs, may be considered to create pleasant scenery.

At present the location of present Yusufeli Town does not provide a scenic or special landscape, when it is considered in the regional context. The new district center will be located along the future reservoir and around a small bay to be formed by the reservoir. This is considered to be a positive effect on how the relocation site is perceived.

Impacts on Historical Sites

Tekkale Citadel would be inundated by the impoundment, since the highest point of this citadel has an elevation of 697 m ASL. Therefore, necessary studies will be carried out for the relocation of this monument, budget will be provided by DSI and Tekkale Citadel will be relocated to a place that ideally would be visible as a landmark and provide access and facilitate touristic use.

Other than the Tekkale Citadel, two chapels (Hamzat-I Chapel near Bagozu Quarter of Yusufeli town and Hamzat-II Chapel between Yusufeli town and Tekkale, both dated to 10th century based on the construction technique) were identified in the reservoir area during the field studies in 2005. Neither of these chapels are registered monuments. Further studies need to be carried out to determine the necessity for the relocation of these chapels. The further surveys, studies and activities to be carried out by Ministry of Culture (Trabzon Cultural and Natural Wealth Preservation Committee) will be coordinated by the project owner (DSI).

Moreover, the Ministry of Culture and the Directorate of Trabzon Cultural and Natural Wealth Preservation Committee will be immediately informed about any archeological finds during the construction phase, which might constitute cultural and/or historical assets. In such a case, construction in the discovery area will be stopped till the experts from the Trabzon Cultural and Natural Wealth Preservation Committee reach the site and examine the finds and decide about any necessary actions. After the necessary actions are taken for the preservation of those assets construction will continue accordingly.

Impacts on Tourism

With the realization of the project rafting tourism on this section of Coruh will cease. The realization of the hydropower projects in the Coruh River Basin may initiate investments, including tourism, in the area and formation of the reservoir may create new opportunities for recreation and tourism.

V. ANALYSIS OF ALTERNATIVES

The project was first put into 1997 Investment Program by the Turkish Government as a part of the Development of Coruh River Basin. In this development plan, three large reservoirs are to be constructed at Laleli, Yusufeli and Deriner sites, located at the uppermost, middle and lower parts, respectively, to regulate the Coruh River flow. In the feasibility studies of all these projects, each project was not only evaluated to be feasible in itself, but also their feasibility was assessed in integration with all the projects proposed in the Coruh Basin. These projects are not only interrelated with respect to their operation to produce energy, but also with regard to the infrastructure (transmission lines, highways, etc.) that they need and which they would affect.

Project Type

In the feasibility studies, an initial consideration of an alternative project producing same amount of energy as Yusufeli Project indicated a coal-fired thermal power plant (TPP), and the Yusufeli as it was estimated that realization of the Yusufeli Project would be about four times cheaper than providing the same amount of power by the alternative coal-fired thermal power plant. From today's perspective, concerns about disruptive fossil fuel markets and uncertain pricing, the current difficulties in political and public acceptance of nuclear energy over questions of risks involved and the unresolved disposal of nuclear wastes, and the global environmental consequences of using thermal energy sources particularly the emission of greenhouse gasses have all placed greater emphasis on sustainable energy policies, which include the development of renewable energy supplies. Thermal power plants based on domestic sources, which is mainly lignite, had not been implemented in Turkey since 1990s due to the severe environmental problems associated with the low quality domestic fuel. Hydropower at present is the only domestic source, which can provide reliable low cost energy, which in addition is renewable. Thus, the Yusufeli Dam and Hydroelectric Power Plant Project is more viable, first for above reasons and secondly as it is integrated part of the development of the hydropower resources within the Coruh cascade.

Project Location

Alternative dam site locations for the Yusufeli Project were considered during the feasibility studies done by JICA in 1986, before selecting the proposed site. An alternative set-up (3-dam scheme) for the middle Coruh was investigated in order to avoid the inundation of the Yusufeli Town. Within the Coruh development plan, three large reservoirs are to be constructed at Laleli, Yusufeli and Deriner sites, located at the uppermost, middle and lower parts, respectively, to regulate the Coruh River flow. The drainage area of the Coruh River abruptly increases (by 1.9 times) after the Oltu River joins the main stream. Therefore Yusufeli Project, the second largest of the Coruh development plan after Deriner Project with respect to the installed and production capacity, was designed to be constructed about 800 m downstream from the confluence with Oltu River. Artvin Dam, located 19 km downstream of Yusufeli dam site, was planned and designed to make use of the residual head between Yusufeli and Deriner projects. By this planning the hydropower resources of the middle Coruh are utilized by two dams , Artvin and Yusufeli.

An alternative 3-dam scheme on the Middle Coruh basin foresees the construction of two dams instead of Yusufeli Dam, one on Coruh River (Kirazli Dam) and the other on the Oltu tributary (Oltu Dam). In this 3-dam alternative, Kirazli Dam located 23 km upstream of the Yusufeli dam site having a high water level (HWL) of 810 m, and Oltu Dam located 10 km upstream from the confluence of Oltu with a HWL of 700 m were proposed instead of the Yusufeli Dam. In the 3-dam alternative plan, Artvin dam would be higher compared to the 2-dam alternative for efficient use of the water head, a dam having HWL of 580 m (instead of

500 m in the 2-dam plan) would be constructed at Artvin dam site (further referred to as Artvin*). The resulting Artvin* Reservoir reaches up to Yusufeli town on the Coruh, however without inundating the town except for 4 hamlets. The head available from Kirazli Dam to the high water level of Artvin* Reservoir would be utilized by a water conduit (power tunnel). The head of the Arkun Dam would be cut by the Kirazli Dam by 100 m.

As a result of the evaluations at that time, it was concluded that the set-up of the 2-dam plan was more favorable based on dam cost and storage volume criteria. An evaluation of the 2 and 3 dam alternatives from present day perspective was done with respect to the issues such as energy production, inundation area and characteristics, impact and land use and resettlement needs, required secondary structures (transmission lines and relocation roads).

Cost of Construction:
It was estimated that the investment costs for the 3-dam set-up would be 464 million US$ higher than the 2-dam set-up, when all dams are concrete (Scenario 1), and 476 million US$ higher than the 2-dam set-up, when all dams are rockfill, except Artvin Dam (Scenario 2). Electro-mechanical equipment cost of the 3-dam alternative will be 1.37 million US$ more expensive than 2-dam alternative. Estimated cost for the relocation roads in 2-dam alternative is 350.60 million US$, while the estimated cost for relocation roads in 3-dam alternative is 310.90 million US$. For the 2 Dam Alternative, the estimated cost for the 7 km transmission lines is 1.54 million US$ and for the 3 Dam Alternative the estimated cost for the 14 km transmission lines is 3.08 million US$.

Consequently the overall investment costs excluding resettlement costs for the 2-dam set-up is about 427 million US$ less than the 3-dam alternative in Scenario 1, and 398 million US$ less than the 3-dam alternative in Scenario 2.

Inundation Losses and Resettlement Need:
The total area to be inundated in the 3-dam alternative is 22.5% less than the area to be inundated in the 2-dam alternative, while the agricultural land to be lost in 3-dam alternative is 12% less, when compared with the 2-dam alternative. The difference between the total areas to be inundated by 2-dam and 3-dam alternatives is 8.10 km^2. The difference between the total inundated agricultural lands is 1.11 km^2.

The total number of households that would have to resettle in 2-dam and 3-dam alternatives is estimated to be 1,954 and 414 respectively.

The adopted approach and estimations demonstrate the costs of the land acquisition and compensation and resettlement (overall resettlement cost including the establishment of a new district center) of the 3-dam alternative as being about 151 million US$ less than that of the 2-dam alternative. The cost of land acquisition and resettlement of the 3-dam alternative is 42% of that of the 2-dam alternative.

Environmental Considerations:
From potential environmental impacts side, apart from inundation it can be noted that the Kirazli Project considered in 3-dam alternative includes an energy tunnel with 13-km by-pass conduit between Kirazli Dam Site and the Kirazli Powerhouse, which will result in impacts on aquatic biota in this reach. However, also in the 2-dam set-up Arkun Project will have effects of the same nature on the Coruh River as it will have an energy tunnel of about 13 km. Therefore, with regard to the downstream effects on Coruh River there is no difference between the 2 and 3 dam alternatives, since the Artvin Dam is at the same location for both cases.

Benefits :
The optimized annual energy production of the 2-dam alternative is 511 GWh/year more than the 3-dam alternative. At the rate of 0.0892 US$/kWh, the yearly revenue benefit of the unoptimized 2-dam alternative over the 3-dam alternative is 33.9 million US$ or 1,695 million

US$ for the 50 years. The energy production benefit of the optimized 2-dam alternative over the 3-dam alternative is 45.58 million US$/year, or 2,279 million US$ for 50 years. Calculated at a discount rate of 7% per annum, the net present value (NPV) of the revenue difference of 1,695 million USD for the un-optimized case is 467.79 million USD.

Conclusion on Location Alternative:
In total investment cost considering the resettlement costs, the 2-dam set-up is by 276 million US$ and 247 million US$ cheaper than the 3-dam alternative in Scenario 1 (all concrete dams) and Scenario 2 (all rockfill dams, except Artvin), respectively. The total investment cost for the 2-dam alternative is 2,230 million US$ versus 2,506 million US$ for the 3-dam alternative in Scenario 1, and 1,976 million US$ versus 2,223 million US$ for the 3-dam alternative in Scenario 2.

The decision for the 2-dam alternative taken as a result of the feasibility study of JICA in 1986, based mainly on construction costs and storage parameters, can still be regarded as economically viable from today's perspective. This is due to the fact that the difference in investment costs is significant and also the expected energy benefits in the long run are clearly in favor of implementing the 2-dam set-up. Although losses and resettlement requirements of the 2-dam set-up are significantly higher than the 3-dam alternative, in order to make use of the investment cost saving and long-term energy revenues, about 12% of the total investment cost in this comparison is calculated for mitigating and compensating the resettlement consequences of the 2-dam set-up.

Finally, from present day perspective the 3-dam alternative would not be compatible with the planned development of the upper Coruh Cascade, which has reached substantial progress in preparation for implementation.

Project Development Type and Scale

Preliminary comparisons indicated that among the four different dam types (concrete gravity dam, arch gravity dam, arch dam and rockfill dam) concrete gravity and arch gravity dam types were economically disadvantageous considering the dam construction cost. Optimization studies were carried out for two alternative dam types (arch dam and rockfill dam) and for project development scale. Underground and surface type power plant alternatives were also considered for each dam type. The benefit-cost ratio was highest (1.87) for the rockfill dam with underground power plant, which is selected as the optimum layout in the further studies for the determination of project scale.

In contemplating the high water level, comparison studies were made for four cases: 690 m, 700 m, 710 m, and 720 m. The area to be inundated is approximately 36 km^2 at high water level of 720 m, while it decreases to 32.4 km^2 at 710 m, 29 km^2 at 700 m, and 25.7 km^2 at 690 m high water levels. Tekkale Citadel is the only historical asset to be inundated in all of the studied high water levels, since it is located between elevations of 670 m and 697 m ASL. DSI has already ensured funding for the relocation of this citadel by allocation of a budget of about 240,000 US$ in the 2005 Fiscal Year Expenditures Program on line 5 of the Yusufeli Dam and HEPP Project Allocations Section. It will be relocated before impoundment.

For different high water levels (HWL), the numbers of villages whose inundation can be avoided differ, albeit not by a significant extent. However, Yusufeli Town will be inundated, when any one of the evaluated HWL are selected. The cases for the number of buildings, total amount of agricultural lands, and total land inundated were also studied. During the feasibility studies the high water levels of 700 m and 690 m are found to be not economically and technically viable as the effective storage capacities decrease by about 12 % and 22%,

respectively, when compared to 710 m HWL. When comparison given above is summarized for the 710 m and 700 m HWL, (since 700 m HWL alternative has a closer effective storage capacity to 710 m, which was reported in the feasibility report to be a significant criteria used for selection) the following can be concluded. At 700 m HWL, the total area to be inundated, the riverine habitat to be lost, the forest area to be lost, the agricultural areas to be lost, the number of building to be inundated, the number of villages to be affected, and the effective storage capacity are less than at 710 m HWL. Therefore, it can be said that the 700 m HWL will cause less adverse impacts related to the loss of land, structures and habitats, though the difference of the loss regarding the above-mentioned components is not very big for 700 m HWL and 710 m HWL, but also it will have less energy benefits (due to the decrease in effective storage capacity). The selection during the feasibility studies was mainly based on economic and technical grounds and 710 m HWL was chosen for the project.

For the selection of installed capacity, peak durations were assumed considering the fact that the project site is near the Georgian border and far from the load centers.

Modes of Operation

The target of the Project is to produce as much energy as possible within the limits of technical and environmental boundary conditions (to avoid as much as possible operating the reservoir in its lower range), but simultaneously to avoid spilling occurrences. Different operating modes can be considered in selecting the mode of operation for the Project; base load only; peaking or load following only; and a combination of these.

When the technical characteristics of the project are considered to achieve planned energy production and economic benefits from the project, peaking operation was found to be the optimum operation mode for the Yusufeli Project. In a peaking (or load-following) operation, the Plant would operate to meet a total of 8-hour peak demands daily. In the peak mode of operation three turbines would be operated for the daily peaking (8-hours/day), providing an output of 315-540 MW (depending on the available head) to the TEIAS grid.

Based on the evaluation of present flows of Coruh River and the observations during the field studies it can be said that significant seasonal fluctuations take place in the riverbed in its present state. Furthermore, the bottom outlet is available to be used for minimum releases to the downstream for aquatic life during impoundment. Moreover, based on the project design (EPDC, 1990), the backwater of the Artvin Dam (at full pool) extends up to the Yusufeli Dam. In case Artvin Dam is delayed the daily high flows during full operation may increase the scour of the channel immediately downstream, but will not pose a risk to downstream settlements.

No Action Alternative

If Yusufeli project was not realized, the following consequences may arise: (i) The population and industry are growing rapidly in Turkey and consequently, the energy demand of the country also increases. Since, hydropower is one of the most feasible energy sources for Turkey, not developing this project may result in the establishment of alternative plants, such as coal-fired thermal power plants, which would be less economic, have other adverse impacts on the environment, and are not as sustainable as using a renewable source for energy production. (ii) The whole Coruh River Development Plan would be affected. The benefits from Yusufeli to the firm energy production of the lower Coruh Projects (Deriner, Borcka and Muratli Projects), which are under construction and operation, would not be realized. This would result in economic inefficiency, and affect the economic life of these projects. Without Yusufeli Project the economic life of Deriner Dam will be negatively affected, which would have retained some of the sediments that would reach downstream.

(iii) From a broader perspective, failure to make full use of the available low cost and peaking hydropower energy sources may ultimately limit social and economic development in the country. (iv) On the other hand, total inundation of Yusufeli Town and three villages and partial inundation of 16 villages would not happen and people would not be displaced. There would not be adverse ecological impacts, such as effects on existing river hydrology and sedimentology and aquatic life. Wildlife habitat and agricultural land would not be lost, since the flooding of about a 33 km^2 of land including about 7.5 km^2 agricultural land would be avoided.

VI. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The environmental management plan covers mitigation measures for the identified adverse environmental impacts, the monitoring and institutional requirements. These measures outlined in the main EIA report will be detailed for the specific issues, and implemented accordingly, in the consequent stages of the project implementation by the responsible parties.

VI.1. Mitigation Plan

The mitigation measures for the minimization of the possible impacts of the project are summarized above. The key organizations for the implementation of EMP are DSI, the Consortium and Turkish Electricity Production Corporation (EUAS). DSI and the Consortium will be the main responsible parties for implementation of the EMP during construction and pre-construction phases. During operation phase DSI (for the reservoir) and EUAS (for the operation of the plant) will be the major responsible agencies. Other governmental agencies which will have the responsibility for certain mitigation and monitoring activities will be coordinated by DSI.

VI.2. Monitoring Plan

The monitoring activities to be performed during construction will be carried out in coordination of the Consortium and DSI. For the coordination of the monitoring activities during operation DSI and EUAS will be the main responsible parties. Furthermore, independent external environmental monitoring may also be considered by DSI for the activities that are not under the responsibility of the Owner's Engineer.

During construction Consortium will designate an environmental site manager, who will be responsible for environmental monitoring issues regarding the Yusufeli Project. Monitoring records will be kept by the environmental site manager. Generally, reports will be prepared bi-annually to describe the monitoring activities and their results (including any need for improvement and the means of achieving this). Compliance with national environmental regulations will be strictly adhered to in all phases of the project and for monitoring activities independent consultants can also be employed, when necessary. In the scope of environmental coordination efforts for the construction phase, environmental training of the construction workers will be an important component.

In addition to the above mentioned monitoring requirements, specialists from various ministries, including the Ministry of Environment and Forestry, Ministry of Health, Ministry of Labour and Social Security, may also inspect the project activities, beginning with the construction, till the end of the economic life of the Yusufeli Project. This monitoring will aim to verify whether or not the project activities are conducted in accordance with the requirements of relevant regulations.

The monitoring evaluation will also continue throughout the operation period. During the operation phase, management, and coordination for environmental and social issues regarding Yusufeli Project will be the responsibility of DSI and EUAS. Monitoring will be an integrated part of operation of the project to comply with the standards and improve management practices.

Monitoring activities during Construction Phase will be directed on monitoring of sources and/or elements of Air Quality, Noise, Water Quality, Waste Management, Wildlife, Resettlement and Socio-economy, Cultural and Historical Assets and the implication of relevant management plans, whereas during operation phase the following will be the main issues of monitoring; Reservoir Sedimentation, Hydrology and Water Quality, Waste Management, Wildlife, Aquatic Fauna, Resettlement and Socio-economy, Health and Safety.

VI.3. Dam Safety and Emergency Response

The Yusufeli Dam was designed to meet applicable standards with respect to dam safety. The necessary safety considerations are dealt with in the planning by competent consulting engineering companies. Dam safety measures for Yusufeli Project include the pre-construction phase studies for dam safety cover the engineering works that have to be conducted during feasibility and design studies, and the environmental assessment, which will provide a basis for reliable decision-making. The construction phase mainly includes the implementation of the measures/plans developed for the construction activities, which is also the basic case for operation.

The minimum requirements for emergency preparedness are outlined by the provisions in relevant Turkish laws and regulations. As required by the DSI policy guide, the detailed emergency preparedness plans for dam projects are prepared as regional emergency response plans (since the impacts of a failure in these projects can extend to a regional scale). DSI has established a "Dam Safety Section" in December 2005 within its head office under the *Dams and Hydroelectric Power Plants Department*. The duties of this Section include preparing dam failure analysis, construction completion report, to prepare dam safety files and reports, to set up early warning systems and state of the art Emergency Preparedness Plan. This Section plans to study Coruh River basin as case specific projects for emergency preparedness plan and also has planned to make the list of the potential risks of the existing and planned dams. Within the framework of emergency preparedness DSI has standing instructions to all the regional directorates for the actions to be taken in case of floods and failures, and in this respect the line of communications are already defined.

At this stage of planning a broad outline of possible scenarios and likely consequences are studied for the Yusufeli Project. These scenarios included the catastrophic floods and flood wave from landslides. For catastrophic floods scenario the probable ten-thousand year flood ($HQ_{10,000}$) and maximum flood (HQ_{max}) are taken into consideration. In case there is Artvin reservoir, the number of inhabitants at risk to be affected by the catastrophic flood wave is estimated to be < 25. In the case of no Artvin the number of inhabitants at risk is estimated to be < 125. It should be noted, however that for these valley sections the flood hazards of extremely rare emergencies like $HQ_{10,000}$ or HQ_{max} are the same with or without Yusufeli Dam.

In addition, a landslide in Artvin reservoir might adversely effect Yusufeli Dam and possible conditions and the countermeasures have been investigated for this case during the design studies. In case of sliding at Havuzlu landslide area blocking of the reservoir is likely because of the small volume of Artvin reservoir at this location compared with potential volume of sliding mass. However, the wave that might be initiated at this site will propagate with attenuation and estimated to have a height of about 12 m at Artvin Dam site. By taking such a consequence into consideration the crest elevation of Artvin Dam has been set at 515 m, i.e. 15 meters higher than high water level 500 m, as a safety measure.

DSI will prepare a state of the art Emergency Preparedness Plan one year before the projected date of initial filling of the Yusufeli reservoir. In this plan the roles of responsible parties will be specified when dam failure is considered imminent, or when expected operational flow release threatens downstream life, property, or economic operations that depend on river flow levels. DSI is committed to make clear statements on the responsibility for dam operations decision-making and for the related emergency communications; maps outlining inundation levels for various emergency conditions; flood warning system characteristics; and procedures for evacuating threatened areas and mobilizing emergency forces and equipment. The initial cost estimation for preparing a detailed plan is about 200,000 USD. This budget will be included in investment, land acquisition program and implementation plan budget of DSI of the respective financial year.